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**(54) METHOD AND
APPARATUS FOR ETCHING**

(57) Abstract:

PURPOSE: To reduce damage to a treatment substrate and to improve fine processing properties by carrying out intermittently at least either of a process to attach reactive gas to a surface of the treatment substrate or a process to irradiate particle beam there.

CONSTITUTION: A silicon substrate 20 having an aluminum mask pattern on its surface is plated in a reaction chamber, and cooled at the liquid nitrogen temperature by operating a cooling system. XeF₂ is introduced into the reaction chamber to form a silicon fluoride layer 22 on the silicon substrate where it is not masked by the aluminum pattern 21. Supply of XeF₂ is stopped, and the substrate is irradiated with an Ar ion beam by an irradiation system. Then, the silicon fluoride layer 22 is removed and the etching proceeds. Repeating of the above process e.g. 100 times, enables formation of a specified trench. Thereby, it is possible to carry out selective and well-controlled etching through particle beam irradiation without damaging the surface of the substrate 21.

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